ENEL2CA H1 - Computer Methods I - 2019

Assignment 1: 22 March 2019

Exercise 1.1 : ***Formulation, Computation and output presentation***

(a) You have been tasked by the programming team to write a function `ReadDate` that reads the date of birth of a person born between 1992 and 2013, as `month`, `day` and `year`, and stores it in the calling program. The validity of the stored date must be verified. In other words, if the month entered is not between 1 and 12 inclusive, the function should print a message informing the user that an invalid month has been entered; if the day entered is not correct, the function should print a message informing the user that an invalid day has been entered; if the year is not valid the function must print a suitable message. In a nonleap year February has 28 days, and it has 29 days for leap year; the months January, March, May, July, August, October, and December have 31 days; and all other months have 30 days.

(b) Write a driver program that tests the function `ReadDate` written in 1.3(a).

Exercise 1.2 : ***Minimum of a quadratic function***

(a) Consider a function $f(x) = a + bx + cx^2$, where $c > 0$. Write a C function `Minimum` that takes the coefficients a, b, and c as arguments, and returns the value of x where the function f is minimum.

(b) Write a driver program that tests the function `Minimum` written in 1.2(a).

Exercise 1.3 : ***Largest contiguous partial sum of terms of an array***

(a) Write a C function, FindLargestSum, that receives as arguments an array IntegerArray and its size ArraySize and finds the largest contiguous partial sum within IntegerArray. That is, we want to sum up any number of neighboring elements from the array, starting from anywhere, and find the largest possible sum. For example, if the array contains

$$-3 \;\; 4 \;\; 2 \;\; 1 \;\; 6 \;\; -10 \;\; 0 \;\; -4 \;\; 3$$

then the function should report 9, because $4 + 2 + 1 + (-4) + 6 = 9$ is the largest sum of contiguous elements from that array of numbers. Your function must also provide the starting and ending indices of the summed elements back to the calling function (for the example above the starting point index is 1 and ending index is 5).

(b) Write a driver program that tests the function FindLargestSum written in 1.3(a).

Exercise 1.4 : ***Method of false position to find a root of function***

The method of false position is an algorithm to find a root of a function, that is, to find r such that $f(r) = 0$. Like the bisection method, it begins with the root bracketed between two points x and y such that $x \leq r \leq y$, in the sense that $f(x)f(y) \leq 0$. The algorithm proceeds to select a point m such that $x \leq m \leq y$, and like the bisection method, it then reduces the interval to either $x \leq r \leq m$ or $m \leq r \leq y$, depending on the sign of $f(x)f(m)$. Although the bisection method picks $m = \frac{x+y}{2}$, the method of false position uses the function values $f(x)$ and $f(y)$ to select the value of m. In particular, m is selected to be the root of the line that passes from the point $(x, f(x))$ to the point $(y, f(y))$, as shown in Figure 1.

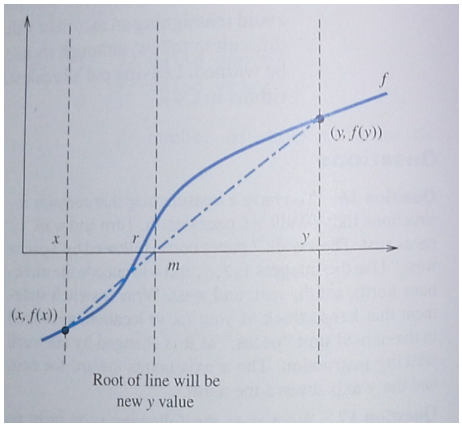

Figure 1: Graphic representation of root computation

(a) Write a function RootOfFunction that uses the false position algorithm for finding the roots of a function of the form double f(double).

(b) Write a driver program that tests the function RootOfFunction written in 1.4(a).

(c) Give a trace of the execution of your program for the following examples:

(c.1) $f(z) = z^3 - 3$ and $x = 1$ and $y = 2$

(c.2) $f(z) = z^2 - 10$ and $x = 3$ and $y = 4$

(c.3) $f(z) = z^3 - 0.165z^2 + 3.993 \times 10^{-4}$ and $x = 0$ and $y = 0.11$

Due : Friday 29 March 2019, via `http://moodle.ukzn.ac.za`

Remember **TEST**1 : **Monday 25 March 2019**